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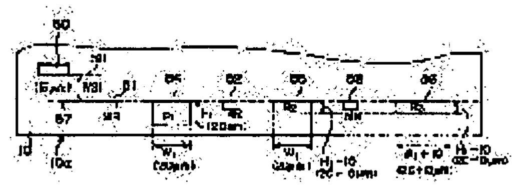
(54) WORK CONTROLLING METHOD FOR WORK PIECE

(57)Abstract:
PROBLEM TO BE SOLVED: To control working correctly and constantly by eliminating an abnormal detected value extremely deviated from detected values by a plurality of sensors using a smoothing method and controlling working.
SOLUTION: In respective sets, MR heights is determined by detecting and calculating resistant values R1 and R2 of a first and a second resistance lapping guide(RLG) sensors 54 and 55. The MR height is calculated by the equation $HMR=(C+S.W1)/R1-RL$, or $HMR=(C+S.W1)/(R2-RL)$; RL: parameter inherent to a bar, R1 and R2: detected resistant data). An RLG sensor showing extremely deviated abnormal value judged wholly is invalidated by using a smoothing method. That is, the detected values from such a RLG sensor are eliminated. A 4th regression curve is calculated by the MR height calculated from the resistance of remaining RLG sensors, and the MR height is ground while driving a linear DC motor in an RLG working machine to suppress the bending of a bar so that the regression curve becomes a straight line.



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CLAIMS

[Claim(s)]
[Claim 1] The processing control approach of the work piece characterized by to measure the amount of processings of a work piece by two or more sensors formed in a mutually different location, to remove the malfunction-detection value which is the approach of controlling processing of this work piece using the detection value of two or more of these sensors, and separated extremely among the detection values of two or more of said sensors using the smooth method, and to control processing.
[Claim 2] Said smooth method is an approach according to claim 1 characterized by being what asks for the rate of change about the distance between sensors which the detection value of an adjoining sensor this adjoins, and removes a malfunction detection value according to the difference of this rate of change to the sensor of the both sides for which it asked about each sensor.
[Claim 3] Said smooth method is an approach according to claim 2 characterized by being what removes the maximum or the minimum value of said detection value as a malfunction detection value when the root sum square value of the difference of said rate of change exceeds the set point according to process tolerance.
[Claim 4] An approach given in any 1 term of claims 1-3 characterized by asking for the average, sigma, and regression line of said detection value furthermore, and removing the detection value which is not included in the setting range according to process tolerance from this regression line as a malfunction detection value.
[Claim 5] The approach according to claim 4 characterized by performing said processing which removes a malfunction detection value in quest of the average, a sigma, and a regression line two or more times.
[Claim 6] The approach according to claim 4 or 5 characterized by carrying out processing control so that the 4th regression curve may be calculated from the detection value which remained and this curve may turn into a straight line.

[Claim 7] An approach given in any 1 term of claims 1-6 characterized by being the bar which two or more thin film magnetic-head sliders with which said work piece cut and obtained the wafer connected.
[Claim 8] The approach according to claim 7 characterized by being height processing which controls the deflection of this bar and adjusts the property of a magnetic-head component while said processing grinds the surfacing side of this bar, and being a value about the amount of height processings detected by two or more sensors by which said detection value was prepared in the location where it differs on this bar.
[Claim 9] The approach according to claim 8 characterized by being the value computed based on the resistance which the value about said amount of height processings measured the resistance of the sensor which changes according to polish and deflection control, and was acquired by this measurement.
[Claim 10] It is the approach according to claim 8 or 9 characterized by making the value which interpolated and calculated the detection value of the sensor contiguous to this sensor into the substitution value of the detection value of the this removed sensor when it is removed noting that the detection value of the sensor located in the edge of said bar among said two or more sensors is unusual.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the processing control approach in height processing of the thin film magnetic head about the processing control approach of a work piece.
[0002]
[Description of the Prior Art] When manufacturing the thin film magnetic head, various processing control is performed about the bar which cut and obtained the wafer for every train so that two or more magnetic-head sliders might be connected and might be arranged. For example, about the thin film magnetic head which has a magneto-resistive effect (MR) component, processing control which polishes the surfacing side (ABS side) of each bar that the height (MR height) of an MR head component should be adjusted is performed. In order to make the property of an MR head component the optimal in this processing control, According to the electric signal from two or more sensors for polishing control called RLG (Resistance Lapping Guide) or an ELG (Electric Lapping Guide) sensor, while processing current MR height, it calculates. Abolishing the variation in MR height of a bar based on this calculated value, controlling a deflection to consider as constant value, and controlling curve correction, a polishing processing stop location, etc. is performed (for example, refer to JP,6-97492,B). Hereafter, this processing approach is called the RLG processing method.
[0003]
[Problem(s) to be Solved by the Invention] However, if the unusual value is included in the detection value of a sensor when performing processing control of MR height etc. based on the detection value of two or more sensors in this way, in connection with it, the amount of processings becomes unusual, in spite of being the component of an excellent article, superfluous polish will be performed and the problem of becoming a defective will occur.
[0004] Therefore, the purpose of this invention is to offer the processing control approach of a work piece that right processing control can be performed, even if outlying observation is contained in the detection value of a sensor.
[0005]
[Means for Solving the Problem] According to this invention, the amount of processings of a work piece is measured by two or more sensors formed in a mutually different location, it is the approach of controlling processing of a work piece using the detection value of the sensor of these plurality, and the processing control approach of the work piece which removes the malfunction detection value which separated extremely among the detection values of two or more sensors using the smooth method, and controls processing is offered.
[0006] The malfunction detection value which separated extremely among the detection values of two or more sensors is removed by the smooth method, and processing control is made with the remaining detection value. For this reason, right processing control can always be performed and the fall of a yield can be prevented.
[0007] As for the smooth method, it is desirable that it is what asks for the rate of change about the distance between these contiguity sensors of the detection value of an adjoining sensor, and removes a malfunction detection value according to the difference of the rate of change to the sensor of the both sides for which it asked about each sensor.
[0008] Furthermore, when the root sum square value of the difference of rate of change exceeds the set point according to process tolerance, as for this smooth method, it is desirable that it is what removes the maximum or the minimum value of a detection value as a malfunction detection value.
[0009] Thus, it is desirable to ask for the average, a sigma (standard deviation), and a regression line further, and to remove the detection value which is not included in the setting range according to process tolerance from this regression line as a malfunction detection value to the detection value which remained. It is more desirable to perform processing which removes a malfunction detection value in quest of this average, sigma, and regression line two or more times.

[0010] It is desirable to carry out processing control so that the 4th regression curve may be calculated from the detection value which remained and this curve may turn into a straight line.
[0011] It is the bar which two or more thin film magnetic-head sliders with which the work piece mentioned above cut and obtained the wafer connected, and it is desirable that above-mentioned processing is processing about this bar.
[0012] Processing of this bar is height processing which controls the deflection of this bar and adjusts the property of a magnetic-head component while grinding the surfacing side of a bar, and it is more desirable that it is a value about the amount of height processings detected by two or more sensors by which the above-mentioned detection value was prepared in the location where it differs on a bar. It is the value computed based on the resistance which this invention set like 1 operative condition, and the value about the amount of height processings measured the resistance of the sensor which changes according to polish and deflection control, and was acquired by this measurement.
[0013] When it is removed noting that the detection value of the sensor located in the edge of a bar among two or more above-mentioned sensors is unusual, it is desirable to make the value which interpolated and calculated the detection value of the sensor contiguous to this sensor into the substitution value of the detection value of the removed sensor.
[0014] This invention is applicable to the various bar processing control using the detection value from two or more sensors besides height processing of a bar. Furthermore, this invention is not limited to the processing control which processes the bar which two or more thin film magnetic-head sliders connected, and can be applied also to the processing control about other various work pieces.
[0015]
[Embodiment of the Invention] The operation gestalt of this invention is explained to a detail using a drawing below.
[0016] Drawing 1 is drawing showing roughly the configuration of some RLG processing systems for performing MR height processing of the thin film magnetic-head slider which has an MR head component as 1 operation gestalt of this invention, and drawing 2 is the block diagram showing the configuration of this operation gestalt.
[0017] The bar which two or more thin film magnetic-head sliders obtained when 10 cut the wafer which is not illustrated in these drawings connected, A bar code reader for the fixture for RLG processing with which, as for 11, the bar 10 was attached, and 12 to read the bar code 13 prepared in the fixture 11, The RLG processing machine for performing MR height processing etc., 14 controlling the deflection of a bar, The personal computer by which 15 is electrically connected to this RLG processing machine 14 and bar code reader 12, Two or more RLG sensors which 16 is prepared on the bar 10 and connected to the computer 15 (sensor for polishing control), The RLG database with which 17 has the fixture number database (JIGNODB) wafer database (WAFERDB) table 18 and 19, and 20 show the RLG sensor height optical measuring unit, respectively. The computer 15, the RLG database 17, and the RLG sensor height optical measuring unit 20 of each other are constituted possible [transmission and reception of data] through the network of LAN21 grade. Although not shown in drawing 2 , two or more connection of the group of a computer 15 and the RLG processing machine 14 may be made at LAN21.
[0018] The fixture 11 is constituted from this operation gestalt by the white ceramic ingredient, and the bar code of the black network showing the fixture number for identifying this fixture itself is formed in that side face of laser beam machining etc.
[0019] The RLG processing machine 14 performs control of the stop location of MR height (or throat height) processing of a bar 10, correction of the deflection of a bar, etc. by control of a computer 15, and its configuration of this kind of the processing machine itself is well-known from for example, a U.S. Pat. No. 5620356 official report etc.
[0020] The RLG sensor 16 is formed in MR head component formation and coincidence in a wafer phase, and the one planar structure is shown in drawing 3 . This drawing is a top view showing some MR head component parts of a bar 10, and one RLG sensor part. However, this drawing is drawing which looked at a part of layer in fluoroscopy, and in fact, since the inductive head etc. is formed on this, it cannot see these MR head component part and a RLG sensor part from a table.
[0021] In drawing 3 a bar and 10a 10 The ABS side of a bar 10 (field ground), Two MR head components in the MR head component by which two or more formation of 30 and 31 was carried out along with this bar 10 at the single tier, One of two or more RLG sensors formed in the field to which 32 **ed between MR head components at an MR head component and juxtaposition the lead to which 30a and 31a were connected to MR layer of the MR head components 30 and 31, 30b, and 31b list, and 30c and 31c were connected to the both ends of the MR layers 30a and 31a -- the conductor is shown, respectively. moreover, the lead to which 32a was connected to the resistor layer of the RLG sensor 32, and 32b and 32c were connected to the both ends of resistor layer 32a -- it is a conductor. The MR layers 30a and 31a and resistor layer 32a are elongated in parallel with ABS side 10a.
[0022] The JIGNODB table 18 is a contrast table (a fixture number is a search key) on which the bar number which identifies the wafer number and bar 10 which identify a wafer, and the fixture number of the fixture 11 with which the

bar 10 is attached contrast, and are registered. The WAFERDB table 19 is the database with which the wafer number was used as the 1st search key, and it used the bar number as the 2nd search key, and is a table registered so that the various data of each bar proper required for processing can take out per bar.

[0023] The RLG sensor height optical measuring unit 20 is equipment which measures optically the RLG sensor height which is not ground in a wafer process, and the RLG sensor height optical measurement data (MSI data are called below) is transmitted to the WAFERDB table 19 in a wafer process through LAN21.

[0024] Drawing 4 is a flow chart which shows roughly the flow of the RLG processing process in this operation gestalt.

[0025] The RLG database 17 is prepared before RLG processing (step S0). Namely, in the wafer phase, the parameter of each bar proper required for count of MR height which calculated beforehand and was obtained from the MSI data obtained from the measurement resistance data and the RLG sensor height optical measuring unit 20 which were obtained from two or more RLG sensors 16, the processing desired value of MR height, processing specification (error), etc. are registered into the WAFERDB table 19 for every bar per wafer. Moreover, each bar 10 which carried out cutting separation from the wafer is pasted up on the processing fixture 11, the bar number which identifies the wafer number and bar 10 which identify the wafer, and the fixture number of the fixture 11 which the bar 10 pasted up are contrasted, and it registers with the JIGNODB table 18.

[0026] Calculation of the parameter of each bar proper required for count of MR height registered into the WAFERDB table 19 is explained below.

[0027] As shown in drawing 5 , on one bar 10, a marker 50, two or more MR head components 51 and 52, and 53 .... are formed in seriate, and the 1st RLG sensor 54, the 2nd RLG sensor 55, and the 3rd RLG sensor 56 are formed them and by turns, respectively. The RLG sensor 54 of these 1st, the 2nd RLG sensor 55, and the 3rd RLG sensor 56 have a mutually different pattern, and two or more sets of these groups are formed 12 sets on one bar, for example (in the case of these 12 sets, in the case of 30% shrink, it corresponds). However, the edge 57 of the ABS side side of an MR head component and a RLG sensor and the opposite side has aligned on the same line parallel to ABS side 10a. in addition, although omitted in this drawing, it was shown in these MR head component and the RLG sensor at drawing 3 -- as -- a lead -- the conductor is connected.

[0028] the 1st width of face and height of the RLG sensor 54 -- respectively -- W1 and the H1 (unit is mum) and 2nd width of face and height of the RLG sensor 55 -- respectively -- W1 and (H1-10) the 3rd width of face and height of the RLG sensor 56 -- respectively (W1+10) -- and (H1-10) -- ** -- it carries out. In order to amend the difference of the pattern dimension design value on a mask, and the pattern dimension on an actual bar here, Distance (MSI) with the edge 57 of the opposite side is measured with the RLG sensor height optical measuring unit 20 the ABS side side of the edge 58 by the side of a marker's 50 ABS side, an MR head component, and a RLG sensor. Increase and decrease of the difference of the MSI data and design value (for example, 13 micrometers) which were measured of amendment are carried out to H1 (also for 20 micrometers and W1, a design value is [a design value] 20 micrometers).

[0029] The resistance R1 of the 1st RLG sensor 54, the resistance R2 of the 2nd RLG sensor 55, and resistance R3 of the 3rd RLG sensor 56 It is given by the degree type.

$R1 = RL+(C+S-W1)/H1 R2 = RL+(C+S-W1)/(H1-10)$

$R3 = RL+ \{C+S- (W1+10)\} /(H1-10)$

however, RL a lead -- a conductor -- the resistance of a part, the sheet resistance in which S becomes settled by the membraneous quality and thickness of a resistor layer, and C show a resisted part (resistance per unit height) of others, such as for example, crowding resistance.

[0030] These formulas to (C+S-W1) RL R1 And R2 If it asks, it will become like a degree type.

$C+S-W1 = -H1 -(H1-10)- (R1-R2) /10 RL = R1+(H1-10) - (R1-R2)/10$ [0031] H1 amended by MSI data like **** Measurement resistance data R1 actually measured from the 1st RLG sensor 54 and the 2nd RLG sensor 55 And R2 from -- an upper type -- using -- C+S-W1 And RL It calculates and registers with the WAFERDB table 19 as a parameter of this bar proper.

[0032] A RLG processing process begins from step S1 of drawing 4 in fact. First, the fixture 11 which the bar 10 which should be processed pasted up is attached in the RLG processing machine 14 (step S1). After equipping, opening (resistance is infinity mostly) and short-circuit (resistance is zero mostly) are checked about two or more RLG sensors 16 of all (step S2). By this check, about opening and a short RLG sensor, it sets up so that that detection value may be repealed henceforth. Subsequently, the bar code 13 of the fixture 11 is read by the bar code reader 12 (step S3).

[0033] Thereby, a computer 15 gets to know a fixture number from the inputted bar code data, searches the JIGNODB table 18 of the RLG database 17 with the fixture number, and obtains a wafer number and a bar number (step S4).

[0034] Subsequently, the WAFERDB table 19 of the RLG database 17 is searched with this wafer number and a bar number, and the parameter of that bar proper, the processing desired value of MR height, processing specification

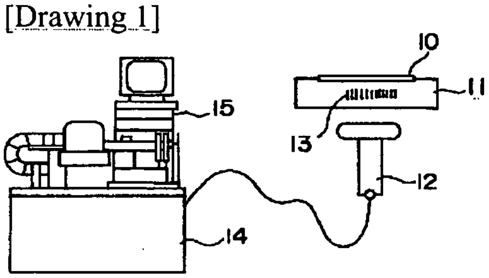
(error), etc. are taken out (step S5).
[0035] Subsequently, an ABS side is ground, performing deflection control of a bar based on this taken-out data, so that MR height of two or more points in a bar may be made into constant value by the RLG processing method (step S6).
(MR height control)
[0036] Drawing 6 is the flow chart which showed the control in this step S6 in more detail. Processing of the following steps S60-S65 is repeatedly performed for every predetermined time, such as 10 etc. seconds.
[0037] first, every based on [detect the resistance from two or more normal RLG sensors 16 which are not made into the invalid at step S2 (step S60), and] this resistance -- the MR height HMR of a RLG sensor is calculated (step S61).
[0038] With this operation gestalt, it sets to each class, and is the resistance R1 of the 1st and 2nd RLG sensors 54 and 55. And R2 It detected and calculated and MR height has been obtained. the MR height HMR -- parameter RL of a bar proper And (C+S-W1) and detected resistance data R1 And R2 from -- it is calculated by the degree type.
HMR=(C+S-W1)/(R1-RL) or HMR=(C+S-W1)/(R2-RL)
[0039] Thus, the RLG sensor about the outlying observation which looked at on the whole using the smooth method, and was extremely left about calculated MR height is made into an invalid, namely, the detection value from the RLG sensor is removed (step S62).
[0040] This smooth method is explained below. Drawing 7 sets to y the value of MR height which computed the location of each RLG sensor from the resistance of x and its RLG sensor, and the graph which plotted x and y on the two-dimensional coordinate is shown typically. 2 point xi-1 which adjoins in this drawing 7 and xi -- inclination k(i-1) i of a between (i= 2, --, n) is computed.
k12 =(y2-y1)/(x2-x1) and k23 =(y3-y2)/(x3-x2) and .. k(n-1) n=(yn-yn-1)/(xn-xn-1)
Such value k(i-1) i becomes each rate of change to the distance between [of these / of the detection value of two adjoining RLG sensors / two] sensors.
[0041] The forward square root of the square [of those differences] sum is computed about two inclination which continues among above-mentioned inclination k(i-1) i. This value serves as a forward square root of the square [of the difference of the rate of change for which it asked about Smooth, i.e., a certain RLG sensor and RLG sensor of those both sides,] sum.
Smooth =root {(k23-k12) 2+--+(k(n-1) n-k (n-2) (n-1)) 2}
[0042] Obtained Smooth For example, Smooth Either the maximum of computed MR height or the minimum value is removed noting that there is outlying observation when a reference value is set to 10, and it is Smooth >10. Decision any shall be removed between maximum or the minimum value is determined as follows. In addition, this Smooth A reference value is determined by MR height precision demanded. first, Smooth the larger value in the value y of MR height related to calculation than these averages <y> -- a value smaller than yU(s) and these averages <y> -- yL ** -- it carries out. At this time, it is yU. The number is yL. It removes maximum, in being fewer than the number. On the contrary, yL The number is yU. It removes the minimum value, in being fewer than the number.
[0043] Subsequently, the same processing is repeated until it calculates Smooth about MR height computed from the resistance of the remaining RLG sensor and this becomes ten or less. Processing by this smooth method is shown in (A) of drawing 8 .
[0044] Then, it asks for the average, a sigma, and a regression line from MR height computed from the resistance of the remaining RLG sensor, and the detection value of the RLG sensor used as MR height from which it separated from within the limits of the vertical 2.5 sigma is removed (step S63). Instead of the range of vertical 2.5 sigma of a regression line, MR height which separated from the range of 30% of upper and lower sides of the average may be removed. However, 2.5 sigmas or the numeric value of 30% is not limited to this value, and can be set as a desired value according to a demand of process tolerance. This processing is shown in (B) of drawing 8 .
[0045] It asks for the average, a sigma, and a regression line once again from MR height computed from the resistance of the further remaining RLG sensor, and the detection value of the RLG sensor used as MR height from which it separated from within the limits of the vertical 2.5 sigma is removed (step S64). Instead of the range of vertical 2.5 sigma of a regression line, MR height which separated from the range of 30% of upper and lower sides of the average may be removed. However, 2.5 sigmas or the numeric value of 30% is not limited to this value. This processing is shown in (C) of drawing 8 .
[0046] In addition, when it is removed noting that MR height computed from the resistance of the RLG sensor located in the endmost part of a bar 10 in the above removal processing is unusual, let the value which interpolated and asked for MR height computed from the resistance of the RLG sensor contiguous to this RLG sensor be the substitution value of MR height for the removed RLG sensor.
[0047] Subsequently, the 4th regression curve is calculated with MR height computed from the resistance of the

remaining RLG sensor, and MR height is ground, driving the linear DC motor which is not illustrating in the RLG processing machine 14, and correcting the deflection of a bar so that the regression curve may turn into a straight line (step S65). This processing is shown in (D) of drawing 8 .
[0048] repeating the above steps S60-S65 to every predetermined time (for example, 10 seconds) -- every -- RLG processing control is carried out until the average of MR height based on the detection value of a RLG sensor turns into a predetermined value. If MR height reaches a value of standard, processing will be ended, but then, the 4th regression curve is a straight line mostly, as shown in (E) of drawing 8 .
[0049] Measurement resistance data R1 finally obtained after RLG processing termination And R2 It stores in the WAFERDB table 19 (step S7 of drawing 4).
[0050] With this operation gestalt, as explained above, since the outlying observation of MR height computed from the resistance of each RLG sensor 16 is removed and MR height control and deflection control of a bar are performed, right data can always perform processing control and the fall of a yield can be prevented.
[0051] Although the operation gestalt described above is the example which applied the processing control approach of this invention about height processing of a bar, it can apply this invention to the various bar processing control using the detection value from two or more sensors besides height processing of such a bar. Furthermore, this invention is not limited to the processing control which processes the bar which two or more thin film magnetic-head sliders connected, and can be applied also to the processing control about other various work pieces.
[0052] This invention cannot be shown in instantiation, and not all the operation gestalten described above can show it restrictively, and can carry out this invention in other various deformation modes and modification modes. Therefore, the range of this invention is specified by only a claim and its equal range.
[0053]
[Effect of the Invention] Since according to this invention the malfunction detection value which separated extremely among the detection values of two or more sensors is removed by the smooth method and processing control is made with the remaining detection value as explained to the detail above, right processing control can always be performed and the fall of a yield can be prevented.

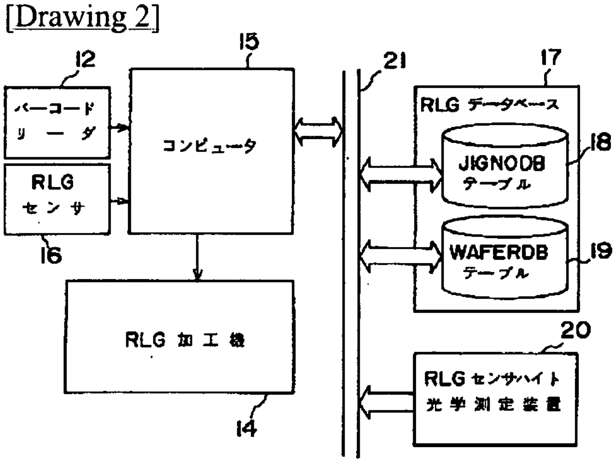
[Translation done.]

DRAWINGS

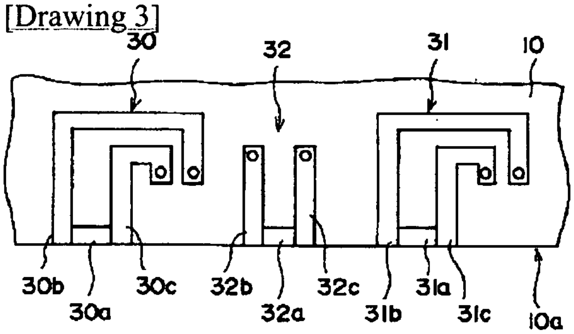
[Drawing 1]



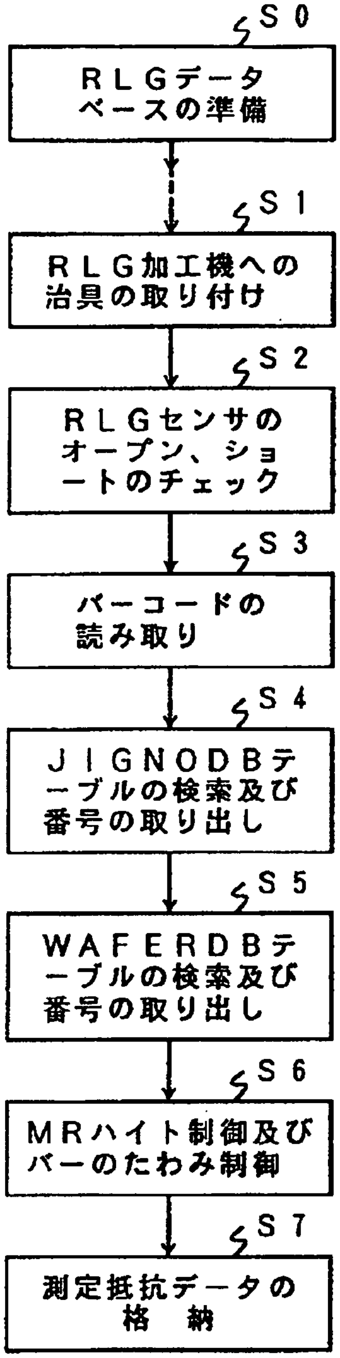
[Drawing 2]



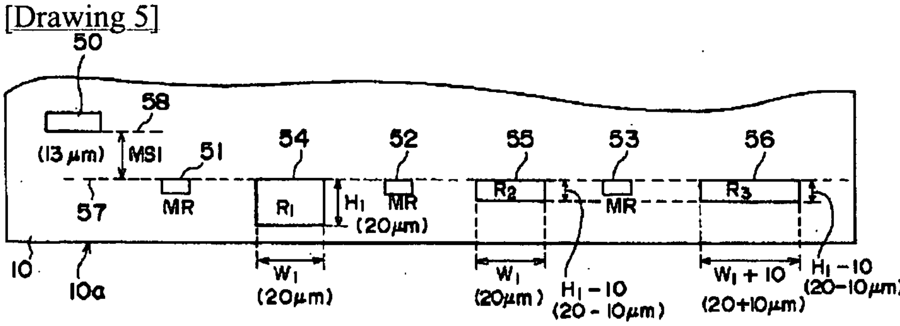
[Drawing 3]



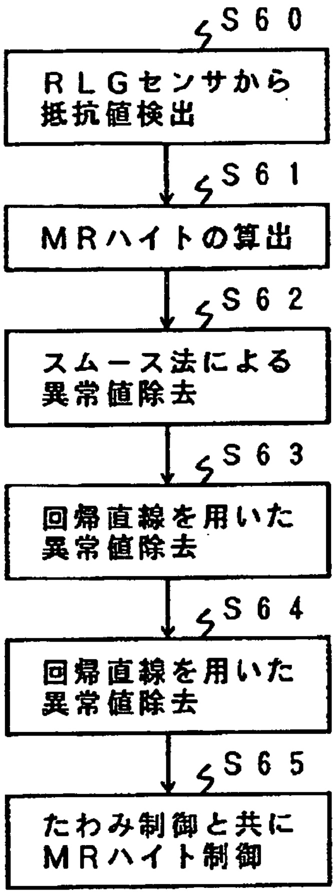
[Drawing 4]



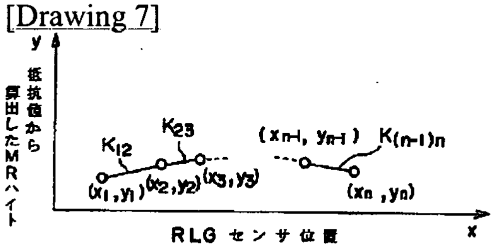
[Drawing 5]



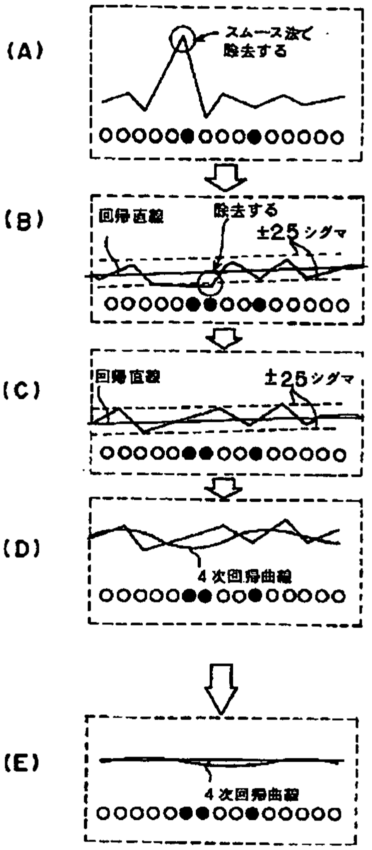
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]